626
P191c
no. 7

REPORT TO THE GOVERNOR

OF THE

ALTGELD HALL STACKS

Advisory Board of Consulting Engineers

Upon its work relating to the Barge Canal from
March 8, 1904, to January 1, 1906.

TRANSMITTED TO THE LEGISLATURE, FEBRUARY 26, 1906.

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With the compliments of

Edward A. Bond

Chairman

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STATE OF NEW YORK.

No. 44.

IN ASSEMBLY,

February 28, 1906.

STATE OF NEW YORK.

EXECUTIVE CHAMBER.

ALBANY, *February* 26, 1906.

To the Legislature:

I have the honor to transmit herewith a copy of the minutes of proceedings of the Advisory Board of Consulting Engineers, covering the period from March 8, 1904, to January 1, 1906.

(Signed) FRANK W. HIGGINS.

REPORT

Hon. FRANK W. HIGGINS, *Governor of New York:*

SIR.—The undersigned herewith transmit to you a copy of the minutes of proceedings of the Advisory Board of Consulting Engineers, covering the period from March 8, 1904, to January 1, 1906, deeming it proper and advisable to render a report of the general conditions surrounding the work under chapter 147 of the Laws of 1903, as called for by section 8 of said act.

Organization of the Board.

The first meeting of the Board was held in their office at State Hall, Albany, N. Y., March 8, 1904, and organized by the selection of Edward A. Bond as chairman, and William B. Landreth as engineer secretary.

Duties of the Board.

Section 8 of chapter 147 of the Laws of 1903 states that the duty of this Board " shall be to advise the State Engineer and Superintendent of Public Works, to follow the progress of the work, and from time to time report thereon to the Governor, the State Engineer and the Superintendent of Public Works, as they may require or the Board may deem proper and advisable."

After carefully considering all of the data that had heretofore been obtained in connection with the surveys, plans and proposed construction of this work; having visited various portions of it, particularly those portions covering the proposed first contracts, and having become familiar with the character of the work through the different sections of the State covered by the four hundred and forty-five miles of canal to be improved under this act,—the Board took up with the State Engineer the consideration of proper specifications, and with the Superintendent of Public Works and the Attorney-General the consideration of a proper form of contract in connection with said specifications, for the letting and governing of the work.

In addition to the duties heretofore noted, and under a concurrent resolution introduced in the Senate, March 31, 1904, creating and appointing a commission to investigate the electrical systems applicable to the canals of the State of New York, the members of the Board became ex-officio members of the State Electrical Towage Commission, constituted by said act.

General Characteristics of Work.

After fully studying the details of former projects and the topographic features of those portions of the State through which this canal passes, it was not only decided to follow out the original plan of canalization of rivers, but to add to this system, by following the low land and utilizing the thread of various smaller streams wherever possible, namely, the Hudson river from Troy to Fort Edward, and Bond and Wood creeks from Fort Edward to Whitehall on Lake Champlain, covering the improvements on the Champlain Canal; the Mohawk river from above Cohoes Falls to the city of Rome; Wood and Fish creeks between the Rome Summit Level and Oneida lake; following Oneida lake and river and the Oswego river to Lake Ontario, and the Seneca and Clyde rivers from the Oswego river through Clyde and Lyons, and through some of the various branches of the Clyde river to a point west of Macedon.

Pertinent to the subject of canalization of rivers, the Board has made a careful study of that portion of the proposed location of the canal between Fox Ridge Station and Lyons, and after considering all of the conditions, having requested the various commercial bodies of the State and canal organizations to confer with the Board at a public meeting held in New York city. January 15, 1906, at that meeting there were present:

Representatives from the Upper Hudson and Champlain Canal district,

The Western New York and Buffalo Association,

The Central New York and Oswego Canal Association,

A committee of citizens representing the Chamber of Commerce of Ithaca,

The Canal Association of Greater New York, including the following associations and others:

New York Board of Trade and Transportation,

Merchants' Association of New York,

Maritime Association, Port of New York,

Canal Boat Owners' and Commercial Association of the State of New York,

New York Lumber Trade Association,

Wholesale Grocers' Association of New York and vicinity,

Canal Forwarders' Association of New York.

After a full discussion it was unanimously—

"Resolved, That this conference approves of the proposed change in the alignment of the Barge Canal through the Montezuma Marshes, following the Clyde river, known as the southern line."

A committee of citizens of the village of Savannah appeared and protested against the suggested change in the canal location.

After having ascertained the sentiment of the canal interests of the State; having ascertained that the "South Route" could be constructed for $162,000 less than the "Middle Route"; although it would increase the length of the Erie Canal five miles; realizing that while the saving of said sum would not in itself warrant the change of line; but knowing that not only the State officers associated with this work, but that this Board desires to so construct this canal that it will meet the requirements of the State to the greatest possible advantage now and for fifty or more years hence; realizing that there is a public sentiment favorable to enlarging and connecting what is known as the Cayuga and Seneca Canal (which is now a part of the Erie Canal system) with this Barge Canal, and knowing that it would save upwards of $1,000,000 to make such connection with the Barge Canal if the "South Line" were adopted,—at a meeting of this Board held December 20, 1905, it was—

"Resolved, That the route south of Crusoe Island, known as the 'South Route,' be recommended to the State Engineer for adoption."

Concrete.

One of the important questions for consideration was that of the use of concrete in permanent structures in lieu of stone masonry, both the Canal Board and the Advisory Board having received petitions from many associations of stonecutters throughout the State, urging the use of the latter.

After consideration of the matter and an inspection of various public works built of concrete, some of which have been in use for years, and some of which are now under construction, along the Big Sandy, Kanawha, Mississippi, Ohio and Allegany rivers; the Illinois and Mississippi canal, and the Trent canal in Canada; at different points between Chicago and Duluth and along several of the Trunk railroads, and in view of the fact that there would be upwards of two and one-half millions cubic yards of concrete or stone masonry which, if built of stone masonry, would increase the estimated construction cost of this work more than $16,100,000, and a careful study of the various public works herein mentioned it was found perfectly practical to build these permanent structures of concrete—it was recommended by this Board and decided by the Canal Board so to do.

Location.

A more detailed and careful study of the location for the final construction of that portion of the Erie Canal lying between the Hudson river and Fairport, N. Y., has caused this Board to recommend to the State Engineer several changes in the plan of construction. In suggesting these changes, the Board has had first in mind the conditions most favorable to the operation of the canal, constantly considering the first cost of construction. For these reasons, it was deemed advisable to make an entirely new location from the point of leaving the Hudson river to a point adjoining the Upper Mohawk river above Cohoes.

The new location permits of the construction of five locks to overcome an elevation of 170 feet from the water surface in the Hudson at Waterford to the new water surface in the Upper Mohawk at the first dam above the city of Cohoes. These five locks, as originally planned, will take the place of sixteen locks on the present old Erie Canal, known as "The Sixteens," an entirely different location for the fixed dams in the Lower Mohawk river, which affects the Erie Canal construction as far as Scotia, west of Schenectady, a distance of 26.5 miles. The new dam on the Upper Mohawk will have a crest elevation about fourteen feet higher than originally proposed. The next dam will be 7.4 miles above the Crescent aqueduct, with a crest elevation sufficient to set the water of the Mohawk river back to Movable Dam No. 4, two miles west of Schenectady. These two dams would take the place of four dams as proposed in the original estimates of the State Engineer of 1901.

Lock Widening.

The advisability of widening and deepening the locks on the Barge Canal to a size which would conform to the size of locks on the Welland Canal, connecting Lakes Erie and Ontario, was much discussed, and this Board was requested by the State Engineer to express its opinion in regard thereto. After most careful investigation and mature deliberation a conclusion favoring such action was reached by the Board, the reasons therefor being set forth in the following preamble and resolution adopted June 28, 1905:

"After due consideration and full discussion of the matter of width of locks for the Barge Canal, submitted for consideration by a letter dated June 23, 1905, from the State Engineer, addressed to the chairman of the Advisory Board of Consulting Engineers for the Improvement of State Canals, said Board passed the following preamble and motion:

"Whereas, The general modern tendency in all countries, especially upon canalized rivers, is to increase the size of the channels, locks and boats; and

"Whereas, The Canadian system of canals from Lake Erie to Montreal has a depth of 14 feet and locks 45 feet wide, and the depth and locks of the proposed Montreal, Ottawa and Georgian Bay Canal will be as great; and

"Whereas, The proposed Lake Erie and Ohio Canal between Lake Erie and the Ohio river will have a depth of 15 feet and locks 45 feet wide; and

"Whereas, The proposed navigation on the Illinois river and on the Mississippi river to St. Louis is to have a depth of 14 feet; and

"Whereas, The advantages of standard dimensions of canals are appreciated by European countries, which are working toward uniformity in the dimensions of international canals and canalized rivers; and

"Whereas, It might be greatly to the advantage of barge owners to employ their barges in coastwise traffic in the winter months during which navigation is closed on the canals, and for which traffic steel model barges of proper width, length, draft and strength would be admirably adapted; and

"Whereas, Increase of depth in waterways importantly decreases the cost of transportation, not only by increasing the tonnage of vessels, but by reducing the tractive force required, by giving more space between the bottom of the boat and the bed of the channel; and

"Whereas, The commercial success of the Barge Canals of the State of New York in competition with other routes—water and rail—will depend largely upon their ability to transport freight at the lowest possible cost, obtained especially by having a waterway and boats of large dimensions; and

"Whereas, About 76 per cent. of the total length of the proposed waterways between New York city and Rouses' Point on Lake Champlain, Oswego and Buffalo will be in open water of rivers, lakes and canalized rivers, and in the remaining 24 per cent. of the distance there is a considerable length where—in rock excavation and elsewhere—there will be, according to present plans, a sufficient width for two 43-foot beam boats to safely pass, and much of the remaining excavation in earth may be conveniently widened any time in the future—and in some parts, where the new canal will occupy the present canal sections in embankment, it may be formed conveniently during construction by moving over one of the banks to the full width required to pass two 43-foot beam barges, without materially increasing the cost—and the necessary deepening between 12 feet and 14 feet may be done in the future when the commerce requires it; and

"Whereas, This Board has ascertained from the State Engineer that the additional cost of building all the locks on the entire system of barge canals 328 feet long (the present proposed length), 45 feet wide and 14 feet deep will not cause the total cost of the canal to exceed the $101,000,000 provided by law, due to economies and reductions in costs in several directions over the original estimate on the basis of which the law was enacted; and

"Whereas, The State Engineer has informed this Board that the provision in the original plans for water for the use of the barge canals and for other purposes is ample to meet the additional amount required for the lockages in the larger locks now proposed; and

"Whereas, In order to provide a waterway of larger dimensions in the future, if desired, all permanent structures should be built and necessary provision made at the outset to meet such enlargement in order to avoid excessive future cost; therefore,

"Resolved, That in the opinion of this Board the locks of the barge canals should be built of the following dimensions:

"Three hundred and twenty-eight feet clear length between hollow quoins, 45 feet clear width, and 14 feet depth over mitersills."

The subject was then taken up by the Canal Board, which concurred in the opinion of the Advisory Board as to widening the locks, but did not favor at this time their being deepened.

The Board has recommended that the right of way be wide enough for future enlargement of canal sections, and in making plans has provided that spoil shall be so deposited that it will not have to be rehandled for the excavation if the canal is subsequently enlarged.

Mohawk River.

One of the most difficult problems has been the consideration and adoption of a plan by which the Mohawk river could be successfully canalized. This river has a watershed of about 3,400 square miles above its junction with the Hudson river, from which at times of freshet there is a maximum discharge of about 100,000 cubic feet of water per second. From observations of floods caused by severe rain storms during the past ten years the conclusion has been reached that a flood of 35,000 cubic feet per second may occur in the Lower Mohawk during the navigation season from May 1st to December 1st, but probably will not occur more than once each year, and that the duration of this flood will not exceed a period of more than two days. It is believed the extreme flood will not occur except at intervals of several years. After a careful consideration of all of the data obtained in regard to floods in the Mohawk river, and taking into account gauge readings that have been established for the last six years, it has been decided to recommend the construction of two fixed dams, as heretofore mentioned, on the Upper Mohawk between Cohoes and the city of Schenectady, and eight movable dams between Schenectady and the dam at Rocky Rift feeder across said river, six miles east of Little Falls. The various types of movable dams now in use throughout the world have been carefully considered for that portion of the river between Schenectady and Little Falls heretofore mentioned, and the Board recommended the construction of what is known as a bridge type movable dam.

This type answers a two-fold purpose. It permits the governing of the water surfaces at pools above each dam and at the close of navigation the movable portion of the dam is suspended under the bridge out of reach of the highest floods; at the same time if it is thought wise in the future to use the bridges for highway purposes with a slight outlay of money for a floor system and approaches to the bridge on either end, it can be made serviceable for the various communities on either side of the valley at each location.

This type of dam has been successfully used in Bohemia on the River Moldau, and is now proposed for use on the Lower Seine in France.

We enclose photographs giving various views of the Moldau dam.

No. 1 shows the span of the bridge with a portion of the lifts of the dam in position and another portion up.

No. 2 shows the dam in position with the water held in place, looking from below the dam.

No. 3 shows the dam in position with the water held in place, looking from above the dam.

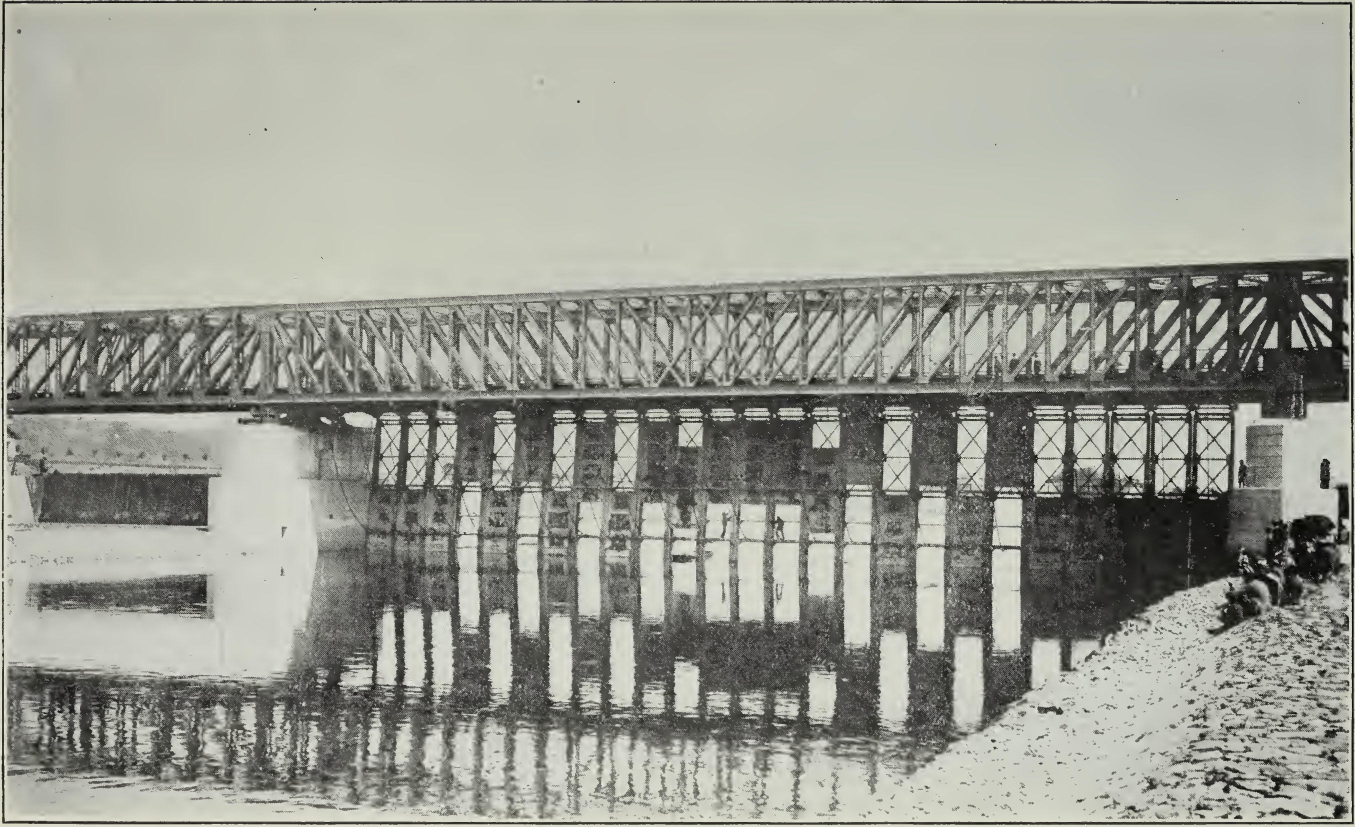
No. 4 shows a graphic picture of the dam in place.

The one we suggest constructing will show a continuous dam across the river as indicated by sketch, showing General Design of Bridge Dam with Boule Gates.

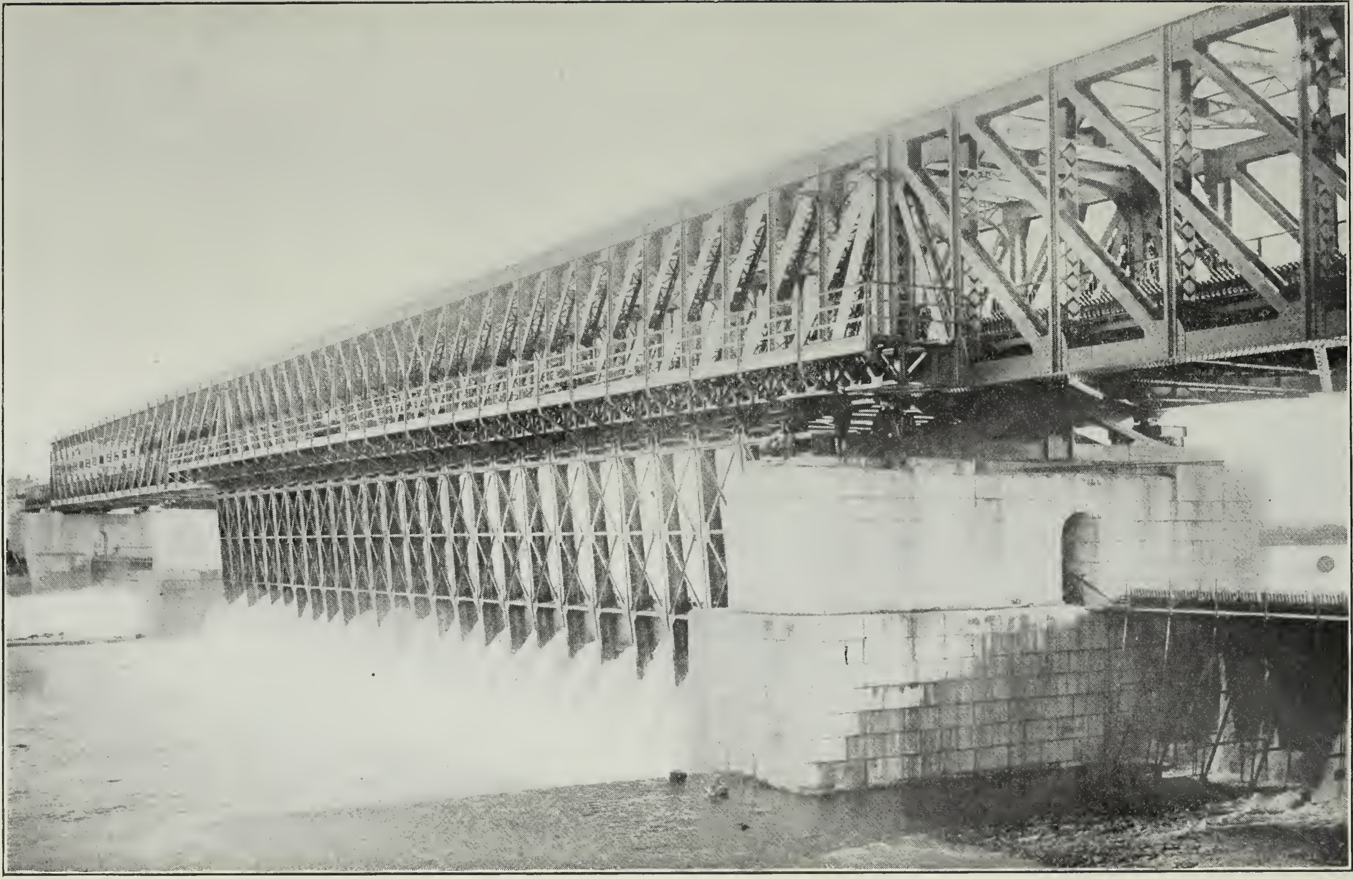
We also enclose sketch showing the cross-sections with dam in position and one with dam raised, and an elevation across the river showing the location of the lock at one end, with the bridge next to it in position, the central and farther spans partially raised.

Classification of Excavation.

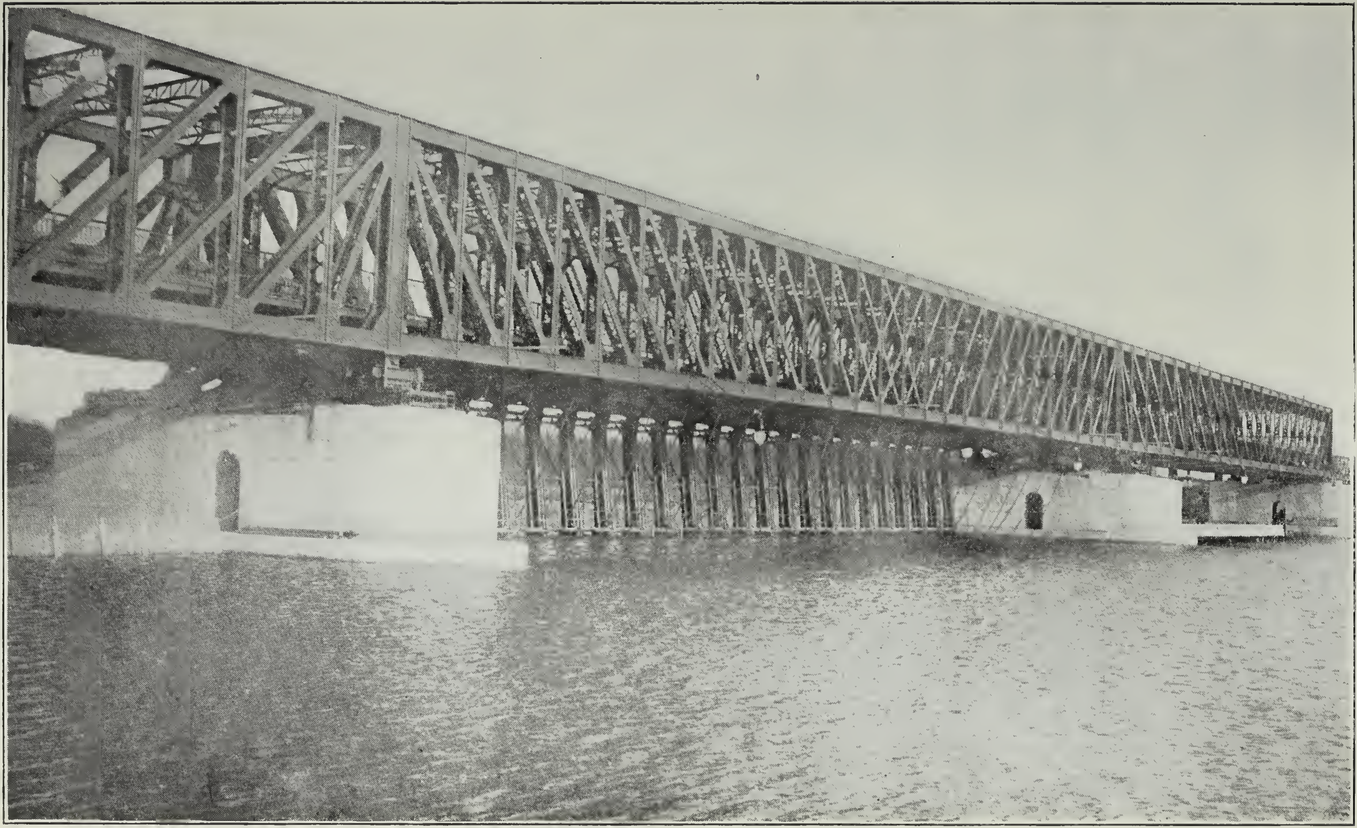
The elimination of classification of excavation was carefully considered. This method was found to be in practical use on many large railroads in this country as well as in some of the U. S.



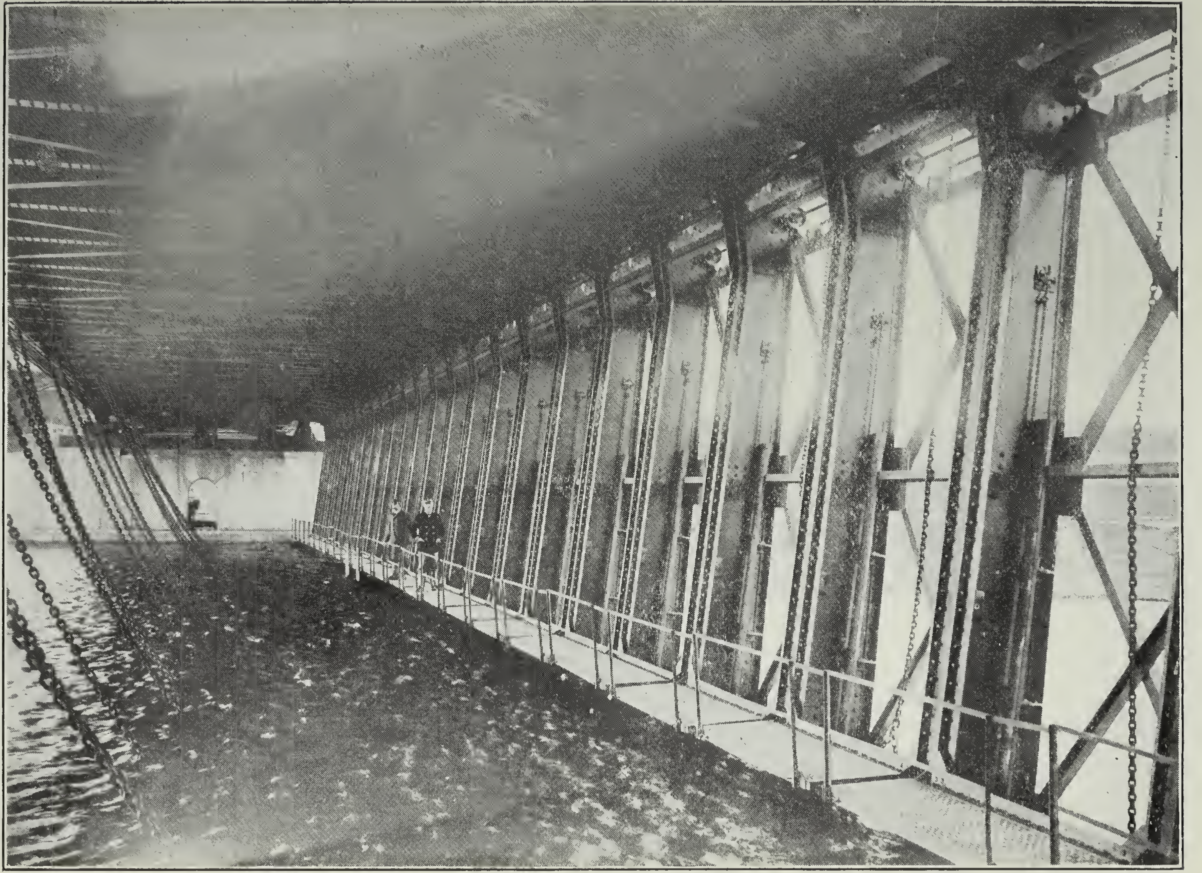
No. 1. Span of Bridge, Portion in Position and Portion Raised.



No. 2. Dam in Position — View Below Dam



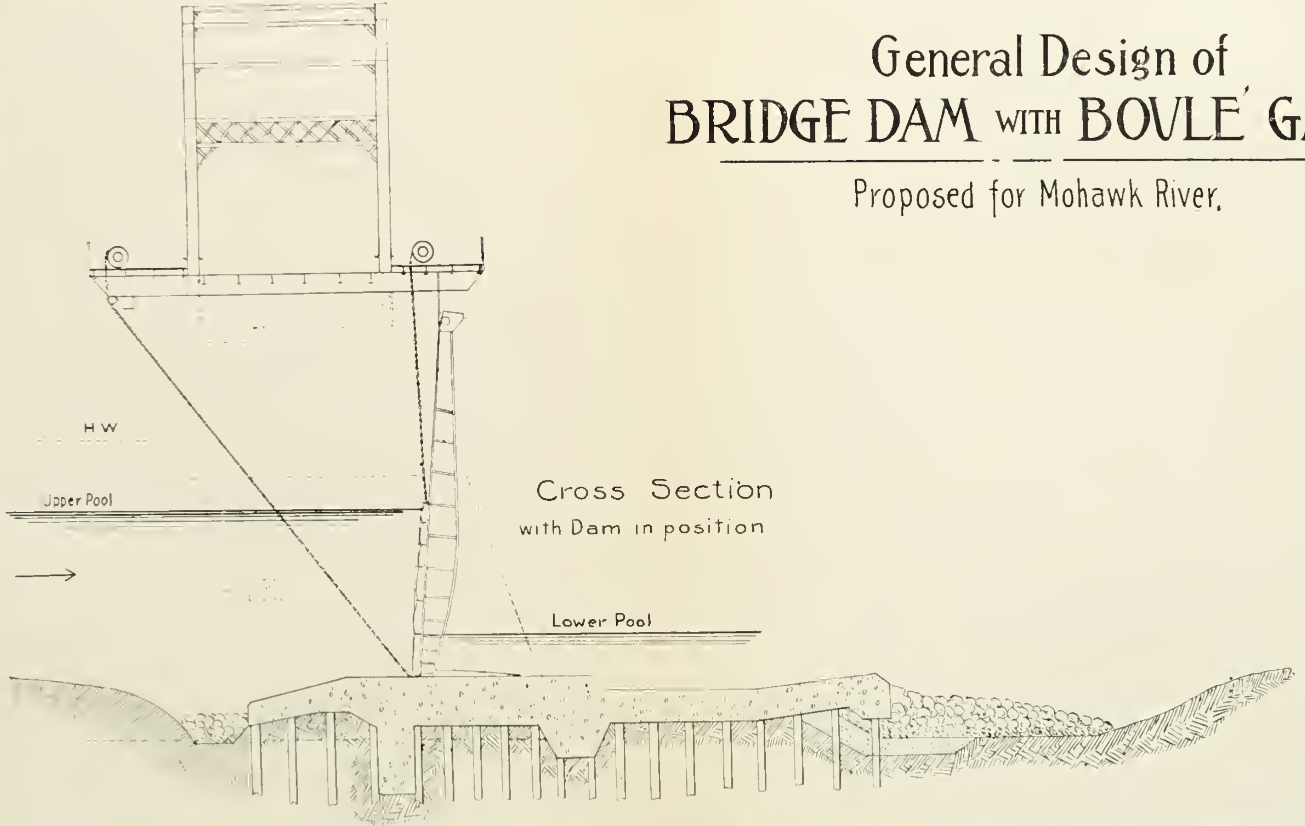
No. 3. Dam in Position — View Above Dam



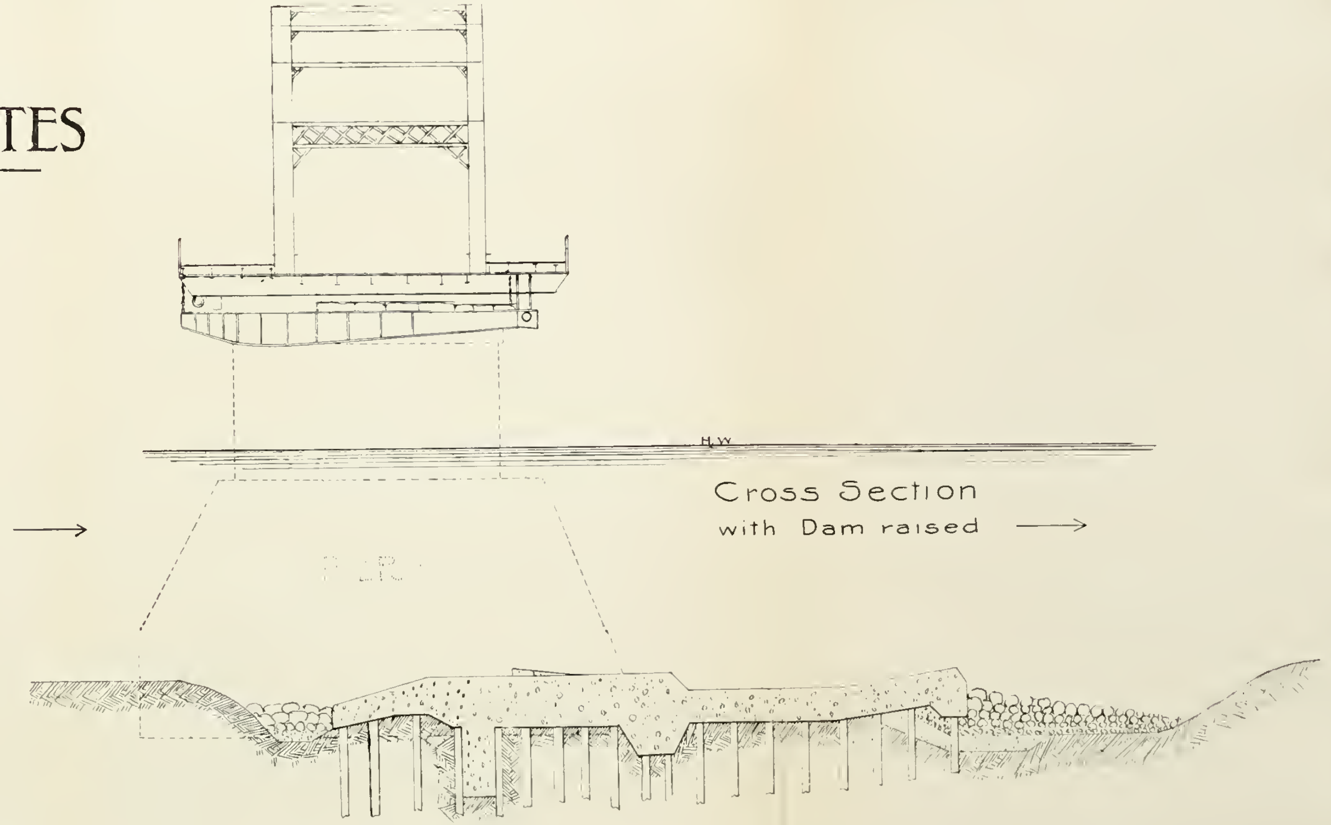
No. 4. Graphic View Showing Heavy Construction.

General Design of
BRIDGE DAM WITH BOULE' GATES

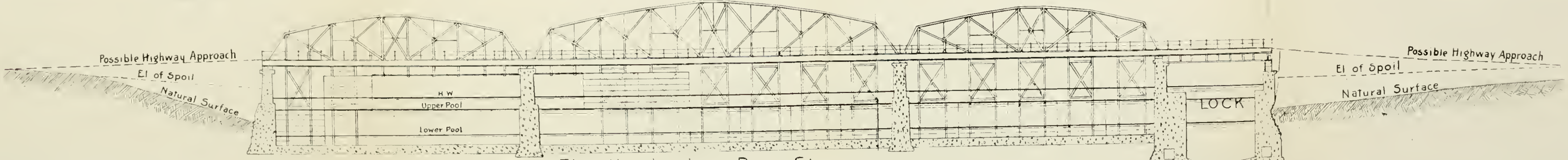
Proposed for Mohawk River.



Cross Section
with Dam in position



Cross Section
with Dam raised



Elevation Looking Down Stream

Department State Engineer and Surveyor

Government Works, and in order to avoid disputes between contractors and engineers which have heretofore almost invariably arisen in public works, the Board recommended and later the Canal Board approved, receiving bids with one unit price per cubic yard, covering all material excavated. This method on the six contracts already let has proved to be practicable.

In the excavation various classes of rock are encountered, varying from that of the Hudson river shale to the hard gneiss rock at Little Falls; while there is limestone and Medina sandstone in various sections of the State. In earth excavation all classes of hardpan will be encountered and various kinds of soil, ranging from hydraulic dredging in the beds of rivers to the most economical class of excavation, namely, sand and gravel.

The material excavated varies from the different classes of earth to that of hardpan and finally to a rock formation, and if let under a classification leads to disputes; while if the whole is let *without* classification (and there are careful borings and soundings as has been the case in this work), contractors are able to bid intelligently for the total excavation per cubic yard without classification, thus placing this ordinarily disputed question beyond the differing opinions of individuals.

Terminals.

The question of terminals at Tonawanda or Buffalo and at New York city has been brought to the attention of this Board by various commercial organizations interested in the canal, and was emphasized by statistics presented at a hearing before the Congressional Committee on Rivers and Harbors before such committee, in aid of an appropriation from the Federal Government for the construction of a ship canal around the rapids at Black

Rock near Buffalo, which would permit upper lake steamers to lock around these rapids and to pass down the Niagara river to Tonawanda. Since that hearing such an appropriation has been made and contracts for beginning this work have been awarded by the Federal Government.

Lockport and Tonawanda Levels.

The Board has been considering the advisability of lowering the level of the canal for a distance of eighteen miles on the Lockport and Tonawanda Level, thus eliminating the present dam at Tonawanda and permitting vessels to proceed from the Niagara river to Lockport before encountering a lock. By a careful analysis of the situation it has been found that this level can be lowered six feet for the additional cost of substantially $80,000. In case this plan is finally adopted, it will permit of using that portion of the Niagara river and the land fronting on it from Tonawanda to the sloop lock in Buffalo (a distance of nine miles) for harbor and terminal purposes, making one of the best harbors, if not the best, on the chain of interior lakes. In addition to this, there would be a great saving to the State by eliminating all of the reasons for the claims which, from year to year, are brought before the Court of Claims on account of flooded lands in the vicinity of Tonawanda. It is also estimated that the lowering of this level will materially increase the value of fifty thousand acres of farm land.

The harbor facilities in Rochester, Syracuse, Utica, Troy and other interior cities have been provided for in the original estimates for this work. The matter of terminals at the Port of New York is one which is to be taken up for consideration by the various interests of the State in the near future.

Water Supply.

The determination to widen the locks naturally raised the question as to whether the original plans for the canal would provide a sufficient supply of water for the handling of ten million tons of freight with the widened locks. After carefully reviewing the figures it was found that a sufficient supply was provided to meet all demands incident to said widened locks.

Work Under Construction.

On December 15, 1904, proposals were received and shortly thereafter contracts were awarded for work on six sections of the canal, covering a distance of about twenty-four miles. These six contracts take in all of the various classes of work unless it be possibly some of the extremely hard rock excavation in the vicinity of Little Falls, and the hardpan that has heretofore been found on the Western Division of the canals between Brockport and Medina. There are three locks; one dam across the Hudson river; one guard lock; typical prism excavation, the upper course of earth and the deeper cutting of hard, tenacious, Hudson river shale, and typical river dredging contracts along the Hudson and Seneca rivers. Another section or work from the head of Oneida lake 4.83 miles easterly embodies typical hydraulic dredging. On the Western Division, near Rochester, one contract includes extremely heavy cutting 35 feet in depth at one end, and extends for a distance of 3.28 miles westerly where it terminates in a wedge. The bottom of this large excavation was of rock overlain with earth.

Prominent contractors were well represented in the proposals received for these six pieces of work, including parties from Philadelphia, New York, Chicago, Pittsburg and other sections of the country.

As heretofore stated, these six contracts cover about twenty-four miles, which, by the estimates of cost upon which the appropriation for the canal was made, amounted to $6,478,523. The contracts were awarded for $5,726,933 or 11.6 per cent. less than the estimates. The work being so diversified and being located in such various sections of the State leads us to believe that the remaining portions can be let at a lower price than the estimates upon which the appropriation for the canal was made.

Future Work.

The detailed plans and estimates for about one hundred and seventy-seven miles of canal, as shown in the following schedule, are in various stages of completion and will be perfected between now and the first of September, 1906, so that if deemed advisable by the State authorities there can then be placed under contract upwards of two hundred miles, covering more than one-half the cost of the entire canal and nearly one-half of the total length, being the heaviest portion of the work:

Schedule.

	Miles.	
Fort Edward-Whitehall	22	$5,500,000
Rexford Flats-Cohoes	15	3,300,000
Schenectady-St. Johnsville, 8 locks and dams	47	10,000,000
Oriskany to Contract No. 4	16	4,000,000
Contract No. 12	12	2,000,000
Fulton-Minetto	5	1,300,000
Phoenix-Fulton	3	500,000
Three River Point to Contract No. 5	33	3,300,000
Pittsford to Contract No. 6	6	4,000,000
Tonawanda-Lockport	18	4,000,000
	177	$37,900,000

	Miles.	
Carried forward	177	$37,900,000
Contracts Nos. 1 to 6 (now let and work under construction)	24	
	201	
Water supply		2,100,000
Total		$40,000,000

In most of these the field surveys are completed and the plans for the work in the prism range from 10 to 50 per cent. completed; while the plans for structures of about one-half of this work are from 15 to 45 per cent. completed.

It is the opinion of this Board that the successful completion of the canal at the earliest possible date (and as we believe in the most economical manner) requires that the work enumerated in the foregoing schedule should be presented for bids during the summer of 1906. The contracts will probably range from three-quarters to two millions of dollars each, and the character of the work is such that heavy and expensive machinery is required to successfully handle it. A considerable period of time will be required for the completion of each contract, in some cases possibly from two to three years. Bidders should have an opportunity to thoroughly investigate the work in order that they may bid intelligently, and should feel that there are presented to them inducements in the way of larger contracts and a prospect of steady work, which are sufficient to warrant their investing the large sums of money necessary in order to obtain and install plants capable of successfully and speedily prosecuting any work which may be awarded to them.

Hearings, Meetings and Inspection.

As will be seen by the minutes of the Board herewith transmitted, numerous meetings have been held at the office in Albany, and also in different cities throughout the State; and many inspections have been made by the Board for the purpose of ascertaining the views and wishes of the citizens regarding canal location and its effect upon the varied business interests in those sections where present conditions seem likely to be disturbed. We cite one notable instance for illustration, that of Rochester.

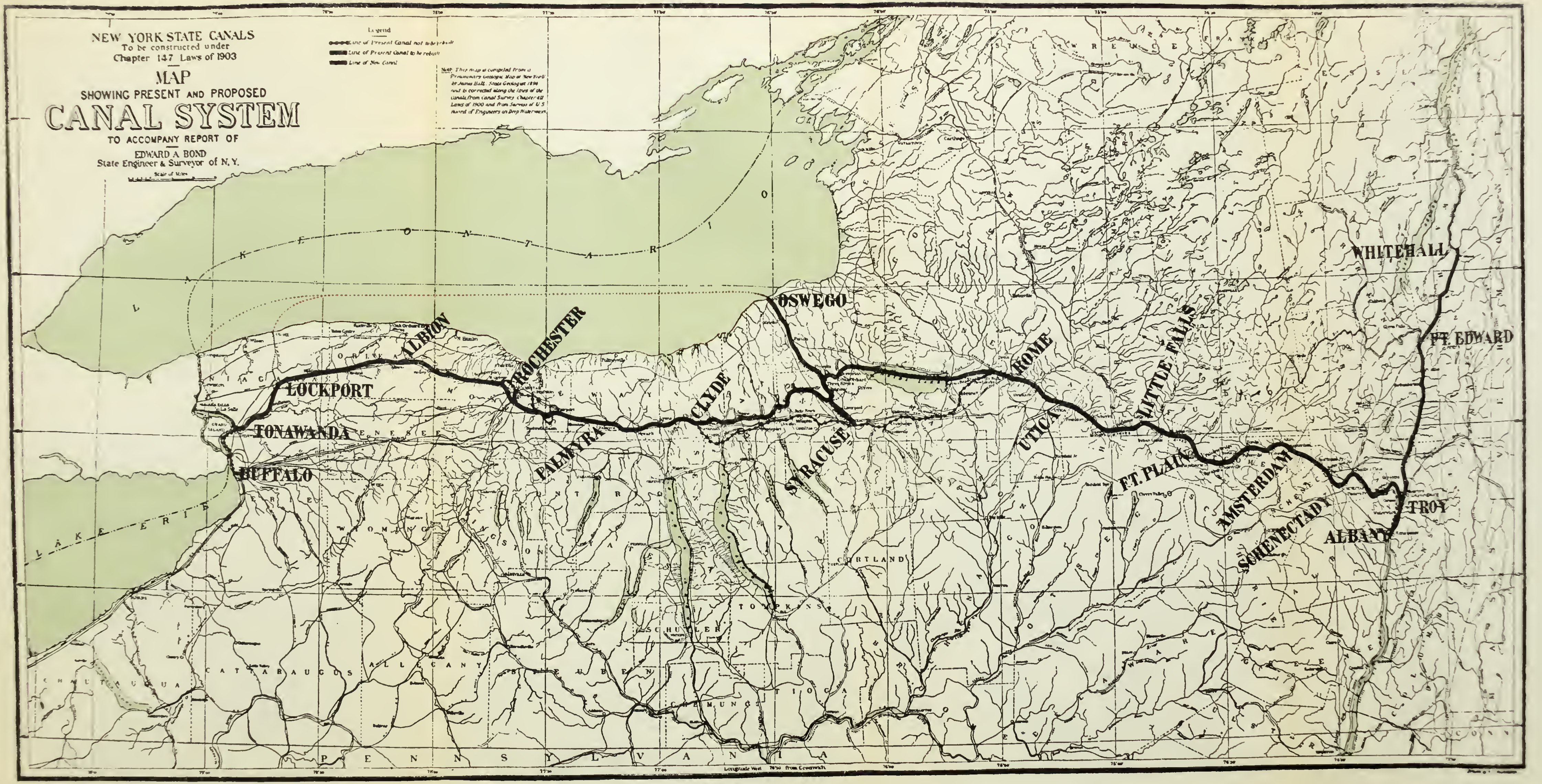
Between Fairport and Rochester there is a low lying section of country adjacent to Irondequoit Bay, causing a deep depression in the formation as far south as Bushnell's Basin and beyond, while between Pittsford and the Genesee river, immediately south of Rochester, is high land reaching to and beyond the river for several miles. In the original surveys in and around Rochester, many lines were considered, some to the north, some to the south and some through the city, and different estimates made. A public meeting was held there to permit citizens to express their views regarding these various routes, and the effect upon the business interests of the city. The matter was deemed of such importance that the mayor of Rochester engaged an expert engineer, Mr. Lyman E. Cooley of Chicago, to take up the study of the conditions and to make recommendations as to what would be for the best interests of the city. The Board placed in Mr. Cooley's hands all the data it had bearing upon the subject, and his report was given due consideration. After a full study of the subject based upon all surveys and examinations to date it seemed advisable to adopt the route south of the city, and this Board has so recommended.

During the time covered by this report, the members of this Board have necessarily been brought in close touch with the Department of the State Engineer and Surveyor, and have had special opportunities of observing the manner in which the Department is organized and conducted. The Board takes this opportunity of expressing its appreciation of the ability and efficiency shown by the officials and employees of the Department, and the personal care and attention that the State Engineer himself is giving to the work in all its details. The Board also desires to record its full appreciation of the co-operation of the other State Departments and officials engaged in the prosecution of the Barge Canal work.

Respectfully submitted,

EDWARD A. BOND, *Chairman,*
W. A. BRACKENRIDGE,
E. L. CORTHELL,
ALFRED BROOKS FRY,
THOMAS W. SYMONS.

Albany, N. Y., February 21, 1906.



NEW YORK STATE CANALS
To be constructed under
Chapter 147 Laws of 1903

MAP
SHOWING PRESENT AND PROPOSED
CANAL SYSTEM
TO ACCOMPANY REPORT OF
EDWARD A BOND
State Engineer & Surveyor of N.Y.

Legend
Line of Present Canal not to be rebuilt
Line of Present Canal to be rebuilt
Line of New Canal

Note: This map is compiled from a Preliminary Geologic Map of New York by James Hall, State Geologist 1894 and is corrected along the lines of the canals from Canal Survey Chapter 411 Laws of 1900 and from Surveys of U.S. Board of Engineers on Deep Waterways.

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